Breast Cancer Diagnosis and Prognosis in Augmented Women

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Background: Recent years have witnessed growing concerns about the possible adverse effects of implants on breast cancer diagnosis and treatment. Numerous reports describe how implants might interfere with mammography and impair the ability to detect cancer. Several publications document the diminished sensitivity of mammography in augmented patients with palpable tumors. However, epidemiologic studies comparing stage of disease at time of diagnosis in augmented and nonaugmented women are equivocal. The purpose of this study was to review the authors' experience with a large number of breast cancer patients to determine whether implants impair early diagnosis or adversely affect prognosis.
Methods: The authors reviewed their prospective database, which contains detailed information on 3953 nonaugmented and 129 augmented breast cancer patients. Various parameters of the two groups were compared and differences were analyzed using appropriate statistical methodology.
Results: The authors' data reveal that augmented patients present with a statistically greater frequency of palpable lesions, have a slightly greater risk of invasive tumors, and have an increased likelihood of axillary lymph node metastases. Despite this, there was no statistically significant difference in stage of disease between augmented and nonaugmented patients; mean tumor size, recurrence rates, and breast cancer-specific survival were virtually identical in both groups.
Conclusions: Based on these findings, the authors conclude that despite the diminished sensitivity of mammography in women with implants, augmented and nonaugmented patients are diagnosed at a similar stage and have a comparable prognosis. While implants may impair mammography, they appear to facilitate detection of palpable breast cancers on physical examination. (*Plast. Reconstr. Surg.* 118: 587, 2006.)

Breast enlargement surgery is popular in the United States; it is estimated that more than 334,000 women underwent elective augmentation in 2004.[1] Carcinoma of the breast is also common, with an estimated annual incidence of more than 267,000 new cases (including both invasive and noninvasive tumors).[2] A woman in the United States now has a 1 in 7 (13.4 percent) lifetime risk of developing breast cancer. Based on these statistics, it can be projected that nearly 45,000 women undergoing augmentation each year will develop breast cancer at some time during their lives.

There does not appear to be an etiologic link between implants and breast tumors. Numerous studies show that the rate of breast cancer is not increased among augmented women,[3–9] and some studies actually demonstrate lower than expected rates.[10–12] However, because a large number of augmented women eventually will develop breast cancer, there have been persistent concerns about possible adverse effects of implants on cancer detection and treatment.[13,14]

There is substantial literature to suggest that implants can interfere with mammography.[15–18] Likewise, several clinical studies document an increased rate of false-negative mammograms in augmented patients with palpable tumors.[19–22] However, when it comes to determining whether implants actually result in cancer being diagnosed at a more advanced stage, the findings are

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Received for publication March 7, 2005; accepted May 16, 2005.

DOI: 10.1097/01.prs.0000233038.47009.04

equivocal. Some studies indicate that augmented breast cancer patients are diagnosed with more advanced cancers than nonaugmented patients,[16,23,24] while other studies indicate that the stage of disease is virtually identical in the two groups.[5,8,25–27]

We have collected data pertaining to a large number of augmented and nonaugmented breast cancer patients treated over a 23-year period. Our data reveal that augmented breast cancer patients are diagnosed more frequently with palpable tumors, have a lower incidence of in situ lesions, and have a greater likelihood of positive axillary lymph nodes. However, tumor size is virtually identical in both groups, there is no significant difference in stage of disease at time of diagnosis, and prognosis appears to be similar in both groups. The finding that significantly more augmented patients present with palpable cancers, while the lesions are the same size as those in nonaugmented women, suggests that implants may actually facilitate detection of breast tumors on physical examination.

PATIENTS AND METHODS

This study comprised a consecutive series of cancer patients treated between 1981 and 2004 at two multidisciplinary breast centers: the Breast Center, in Van Nuys, California, and the Kenneth Norris Comprehensive Cancer Center, in Los Angeles, California. A total of 4082 breast cancer patients were treated; 3953 cancers occurred in nonaugmented women and 129 occurred in augmented patients. All patients were entered into a prospective database, which included, among other information, tumor palpability, size of the primary tumor (measured at the time of surgical excision), nuclear grade, the presence or absence of lymphovascular invasion, and axillary lymph node status. Breast cancer recurrence and mortality rates were also carefully tracked. Mammograms were reviewed (when available) to compare the sensitivity of mammography in augmented and nonaugmented patients with palpable lesions.

Only patients with infiltrating ductal carcinoma, infiltrating lobular carcinoma, ductal carcinoma in situ, and lobular carcinoma in situ were included for the purposes of the current study (unusual tumors, such as angiosarcomas and lymphomas, were excluded). A total of 3922 nonaugmented patients and 129 augmented cancer patients were included in the final analysis.

The data were evaluated by comparing various parameters of the two groups. Statistical significance was determined using several methods as appropriate: comparison of the groups on average tumor size was done with t tests on independent groups; comparison of survival until recurrence and survival until death was done using log-rank tests from Kaplan-Meier survival analysis; and analysis of counts and percentages was done with chi-square tests.

RESULTS

The mean age at time of diagnosis was 53.5 years (range, 22 to 95 years) in nonaugmented women and 46.8 years (range, 29 to 71 years) in augmented patients (Table 1). In the augmented group, for cases where data were available ($n = 104$), implants were present for a mean period of 10.45 years (range, 0.5 to 37 years) before cancer diagnosis. In cases where information regarding the degree of capsular contracture was available ($n = 106$), 30 percent were Baker grade I, 40 percent were grade 2, 22 percent were grade 3, and 8 percent were grade 4.

The distribution of cancers by histologic type was similar in both groups (Table 2). A significantly higher percentage of augmented patients presented with palpable tumors (75 percent compared with 54 percent, $p < 0.0001$) (Table 3). There was a slightly lower incidence of early, in situ lesions in augmented patients (27 percent compared with 33 percent) and a greater incidence of positive axillary lymph nodes (invasive cancers only) in augmented patients (46 percent compared with 35 percent). However, there was no statistically significant difference in stage of disease between the two groups (Table 4). The percentage of patients (invasive cancers only) with lymphovascular involvement was essentially the same in augmented and nonaugmented patients. Likewise, there was no difference in nuclear grade between the two groups.

For purposes of comparing tumor size in augmented and nonaugmented women, only patients with infiltrating ductal lesions were considered. Infiltrating ductal tumors were the type most commonly encountered, and measurements of these lesions were the most reliable. Among the 3922 nonaugmented patients, there were 2235 infiltrat-

Table 1. Age at Time of Cancer Diagnosis

	No. of Patients	Mean Age at Diagnosis
Nonaugmented*	3881	53.5
Augmented	129	46.8
Total	4010	53.3

*Forty-one nonaugmented patients were missing age at time of diagnosis.

Table 2. Type of Breast Cancer

	Nonaugmented		Augmented	
Tumor Type	No.	%	No.	%
Ductal carcinoma in situ	1154	29.4	32	24.8
Infiltrating ductal carcinoma	2330	59.4	86	66.7
Lobular carcinoma in situ	127	3.2	3	2.3
Infiltrating lobular carcinoma	311	7.93	8	6.2
Total	3922	100	129	100

Table 3. Palpability at Time of Diagnosis

	Nonaugmented*		Augmented	
	No.	%	No.	%
Nonpalpable	1756	45.6	32	24.8
Palpable	2096	54.4	97	75.2
Total	3852	100	129	100

*Data on palpability were unavailable for 70 nonaugmented patients ($p < 0.0001$).

Table 4. Stage of Disease at Time of Diagnosis

	Nonaugmented*		Augmented†	
Stage	No.	%	No.	%
0	1272	33.3	35	27.3
1	1206	31.7	37	28.9
2	1092	28.7	48	37.5
3 or 4‡	236	6.2	8	6.3
Total	3806	100	128	100

*Data were unavailable for 116 nonaugmented patients.
†Data were unavailable for one augmented patient.
‡Eleven nonaugmented and zero augmented patients had stage 4 breast cancer ($p = 0.1721$, nonsignificant).

ing ductal cancers and the average tumor size was 23.8 mm. Among 120 augmented cancer patients, 86 had infiltrating ductal lesions with an average size of 23.2 mm (no significant difference) (Table 5).

Mammograms were available for 87 of the augmented patients with palpable lesions. The mammogram failed to reveal an abnormality in 36 cases, for a false-negative rate of 41.4 percent. Mammograms were available for 1741 of the nonaugmented women with palpable cancers and did not visualize the tumor in 153 women, yielding a false-negative rate of 8.8 percent. The difference was significant ($p < 0.0001$) (Table 6).

Breast cancer recurrence rates and breast cancer-specific mortality rates were compared between the two groups. Among 3922 nonaugmented cancer patients there have been 764 recurrences (19.5 percent), and among 129 augmented patients there have been 19 recurrences (14.7 percent), a difference that is not significant ($p = 0.4932$) (Table 7). The Kaplan-Meier analysis of cancer recurrence is illustrated in Figure 1. Death from breast cancer occurred in 412 nonaugmented patients (10.5 percent) and 13 augmented patients (10.1 percent), again a nonsignificant difference ($p = 0.6523$) (Table 8). Kaplan-Meier analysis of breast cancer-specific survival is depicted in Figure 2.

Table 5. Mean Tumor Size (patients with infiltrating ductal cancer only)

	No. of Patients	Mean Tumor Size
Nonaugmented	2235	23.8
Augmented	86	23.2
Total	2321	23.7

$p = 0.8066$ (not significant).

DISCUSSION

The key to early detection of breast cancer is routine mammographic screening of asymptomatic women.[28,29] It has been well established that occult breast cancers, lesions too small to be palpated on physical examination but identifiable on mammograms, have a very high cure rate.[30–32] Because of the effectiveness of mammography in detecting early breast cancer, the American Cancer Society recommends annual mammographic screening of all women age 40 and older.[2]

Silicone gel-filled and saline-filled implants are "radio-opaque" compared with breast tissue (which has a radiological profile similar to fat).[33] As a result, breast implants cast a shadow on mammograms.[22,34] It has long been known that this implant shadow has the possibility of obscuring an early breast cancer.[35–37] To overcome this

Table 6. Sensitivity of Mammography in Women with Palpable Cancers

	Nonaugmented		Augmented	
	No.	%	No.	%
Negative	153	8.8	36	41.4
Positive	1588	91.2	51	58.6
Total	1741	100.0	87	100.0

$p < 0.0001$.

Table 7. Cancer Recurrence

	Nonaugmented		Augmented	
	No.	%	No.	%
No evidence of disease	3158	80.5	110	85.3
Recurrent disease	764	19.5	19	14.7

Kaplan-Meier log-rank, $p = 0.4932$ (not significant).

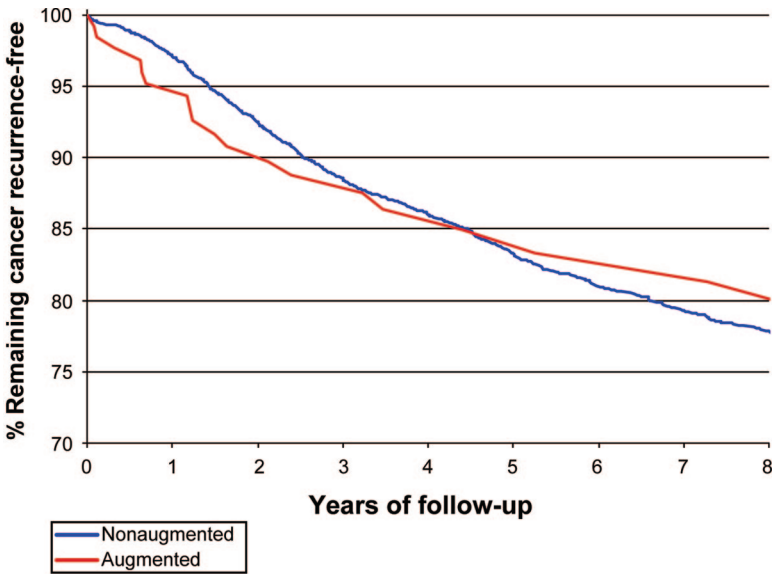

Fig. 1. Breast cancer-free survival.

Table 8. Breast Cancer Mortality

	Nonaugmented		Augmented	
	No.	%	No.	%
Alive	3510	89.5	116	89.9
Dead	412	10.5	13	10.1

Kaplan-Meier log-rank, $p = 0.6523$ (not significant.

impediment, various recommendations have been made, including the use of displacement (Eklund technique) mammography in conjunction with conventional compression mammography in an effort to visualize more of the breast.[21,37–39] However, even with vigilant techniques, it is likely that mammographic screening will be impaired to some extent in women with implants.[17,18,40]

Typically, mammography is highly sensitive for detecting breast lesions. In nonaugmented women with palpable breast cancer, mammography reveals the tumor in more than 90 percent of cases and has a false-negative rate below 10 percent. However, repeated studies in augmented patients with palpable cancers reveal diminished sensitivity of mammography with a significantly increased rate of false-negative examinations.[19–22] Our current data add additional support to this finding, revealing that among women with palpable cancers the false-negative mammography rate was 41.4 percent in those with implants, compared with only 8.8 percent in nonaugmented patients.

Because implants have the potential to obscure lesions on mammography, and because of the increased rate of "false-negative" mammograms in augmented patients with palpable tumors, there has been persistent concern that augmented breast cancer patients are diagnosed with more advanced disease.[13,14,20] However, published studies examining the stage of disease at time of diagnosis are equivocal.

We previously reported that among our breast cancer population, augmented women were diagnosed at a comparatively advanced stage.[16,20] Others have reported similar observations. In the Multicenter Study,[23] Brinton et al. found that augmented cancer patients had a lower incidence of in situ and local disease and a higher rate of axillary nodal metastases and distant spread than nonaugmented patients. Similarly, Karanas and associates[24] reported a low rate of early lesions (stages 0 and 1) and a relatively high rate of advanced disease (stages 3 and 4) in augmented patients with breast cancer. On the other hand, there are numerous reports suggesting that the stage of disease at diagnosis is equivalent in augmented and nonaugmented women.[5,8,25–27] Our updated observations tend to support the conclusion that the stage of disease is similar in both groups at time of diagnosis. Likewise, our series confirms, as others have reported, that augmented patients are not a higher risk of cancer recurrence or death.[25,27,41–45]

Our data do not reveal a significant difference in tumor size, lymph node status, stage of disease, or prognosis between augmented and nonaugmented patients. However, breast cancers were palpable at the time of diagnosis significantly more often in augmented women (75 percent

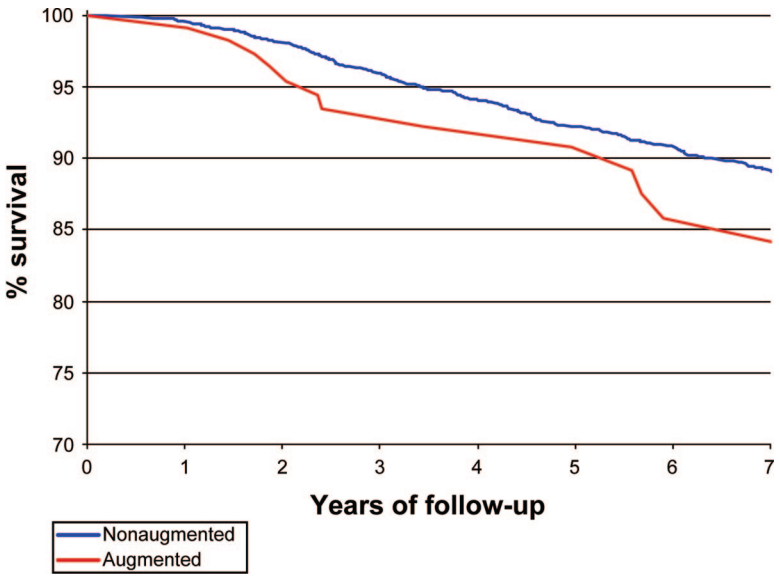

Fig. 2. Breast cancer-specific survival.

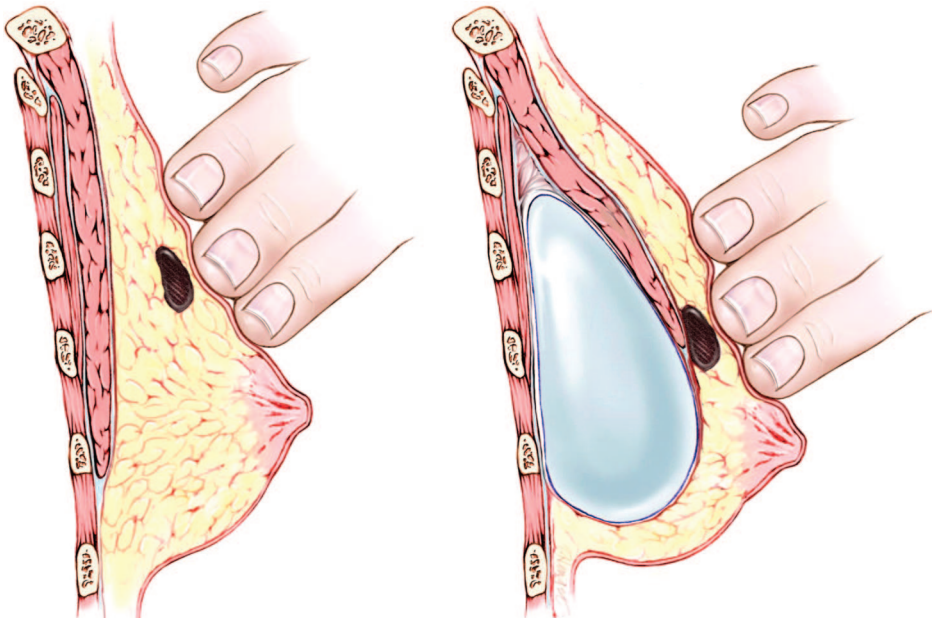

Fig. 3. Comparative ease of palpating a lesion in an augmented and nonaugmented breast.

compared with 54 percent). Since the size of the lesion is virtually identical in the two groups, one explanation might be that the presence of an implant actually facilitates palpation of the tumor. Others have suggested that the augmented breast may be easier to examine,[14] and there are several reasons why this hypothesis is reasonable.

Palpation of a breast lesion is dependent on feeling the abnormality and distinguishing it from surrounding normal breast tissue. This task is much more difficult in women with large breasts and deep tumors, because the lesion simply is not as accessible to the palpating fingers. It is widely acknowledged that breast implants compress breast parenchyma and, over time, cause atrophy of tissue. It is not unusual to observe that the parenchymal envelope in augmented patients has been reduced to a thickness of just a few centimeters, particularly when implants have been present for many years. In our population of augmented cancer patients, implants had been present for an average period of 10.45 years before diagnosis. This is certainly ample time for the prosthesis to have caused tissue compression, thinning, and atrophy (Fig. 3).

Another hypothetical way that implants could facilitate palpation of tumors is by providing a smooth, uniform platform upon which the lesion is more easily appreciated. When the nonaugmented breast is palpated, there are underlying structures, such as the bone and cartilage comprising the sternum and ribs; these tissues have a firm, lumpy consistency. These textural irregularities may make it more difficult to determine whether an abnormality is present. In augmented patients, the breast parenchyma lies atop an implant, which has a uniform consistency and a smooth surface. This homogeneous background provides a uniform substrate upon which the denser, irregular tumor mass may be felt more readily.

Many patients who have had implants for a prolonged period of time develop clinically significant capsular contracture. This decreases the compliance of the implant and results in the surrounding breast tissue being stretched over a relatively immobile, rigid surface. While capsular contracture has been shown to impair mammography, when the thinned out breast tissue is stretched over a rigid, uniform underlying structure (the implant encased in a contracted capsule), this might actually facilitate palpation of abnormalities.

CONCLUSIONS

There are numerous studies suggesting that implants obscure mammographic visualization of the breast. There are also data demonstrating that implants reduce the sensitivity of mammography in patients with palpable lesions. In our review of a large series of augmented and nonaugmented breast cancer patients, we found that tumors were palpable significantly more often in augmented patients and that women with implants had a significantly higher rate of false-negative mammograms. Despite this, tumor size was virtually identical in both groups, with similar results for stage of disease, recurrence rates, and breast cancer-specific survival. These findings suggest that tumors of equal size may be more easily palpated in augmented patients, and this beneficial effect may compensate for the potential impairment of mammography.

Because of the possible adverse effect of implants on visualization of breast tissue, screening mammography may not be appropriate in augmented patients. In most cases, a diagnostic mammogram should be obtained, even in asymptomatic patients. Ideally, physical and mammographic findings should be correlated. Any palpable abnormalities should be studied with ultrasound. In appropriate cases, magnetic resonance imaging should be considered as an adjunct. While many questions about cancer in the augmented breast remain unanswered, our most recent findings suggest that in the typical clinical setting augmented and nonaugmented breast cancer patients are diagnosed at a similar stage and have a comparable prognosis.

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ACKNOWLEDGMENTS

The authors acknowledge the contributions of Rita Engelhardt, Dr.P.H., and Jeffrey Gornbein, Dr.P.H., Department of Biomathematics, University of California at Los Angeles, Los Angeles, Calif., who assisted in data analysis.

DISCLOSURE

Neither Dr. Handel nor Dr. Silverstein has any commercial associations that might pose or create a conflict of interest with information presented in this article. Specifically, neither Dr. Handel nor Dr. Silverstein has any consultancies, stock ownership or other equity interests, patent licensing arrangements, or payments of stipends for conducting or publicizing the study described in the article. Dr. Handel personally paid the expenses related to carrying out this study.

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